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Introduction

Duraiappah, A.K.; Tol, R.S.J.

published in
Computational Economics
2001

DOI (link to publisher)
[10.1023/a:1021078206731](https://doi.org/10.1023/a:1021078206731)

document version
Publisher's PDF, also known as Version of record

[Link to publication in VU Research Portal](#)

citation for published version (APA)
Duraiappah, A. K., & Tol, R. S. J. (2001). Introduction. *Computational Economics*, 18(2), 137-139.
<https://doi.org/10.1023/a:1021078206731>

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Introduction

The articles presented in this special issue of *Computational Economics* focus on some of the recent advances in the use of computational techniques in the field of environmental economics. This endeavor was motivated by a number of factors. There is a growing perception among economists, and in particular environmental economists, of the important role ecological systems play in determining and influencing economic activities. Consequently, there is growing recognition of the need to integrate economics and ecology within a single computational, decision-analytical framework. The complexity of the ensuing integrated systems means that many analytical tools are inadequate and in many cases redundant in any rigorous analysis. Computational techniques offer a solution to fill the vacuum left by the inadequacy of the analytical techniques.

Advances in computer hardware and software have made the task of solving large complex models a reality. These advances have allowed economists to address increasingly complex problems which otherwise could not have been analyzed. We believe that these advances can be extremely useful in addressing problems related to economics and the environment. It can remove one of the main bottlenecks in the field of environmental economics – the ‘dimensionality and complexity curse’, which arises when a multi-disciplinary problem is analyzed within a single decision-analytic platform.

The collection of papers presented in this special issue cover a broad range of subjects, ranging from global climate change at one end of the spectrum to local community forest management at the other. However, we should like to highlight at this point the biased representation of climate change. This was not intentional, but it does demonstrate the rapid adoption of computational techniques by climate change economists *vis à vis* economists working in other fields of environmental economics. We hope that this special issue demonstrates the strengths and advantages of using computational techniques in addressing a broad range of economic-*cum*-environmental problems.

The first paper in this issue, by Wietze Lise, uses a game theoretic model to analyze communal forest management. Unlike the majority of game theoretic studies, which begin by assuming a certain game behavior, this paper uses the data to derive the game structure being played. Lise uses a combination of computer programs to carry out a series of tasks in order to derive the final results. The

traditional notion of using one package or writing a personal algorithm is bypassed and the author demonstrates quite convincingly the strengths of existing computer packages, tapping these strengths by using them in combination but within a single platform.

The next two papers focus on climate change. The first, by Richard Tol, addresses equity issues in the realm of climate change. He approaches the problem from a strategic behavior perspective and uses game theoretic techniques to look at some of the critical factors which will arise in climate change negotiations. The paper derives an analytically tractable version of a complex numerical models, and then employs numerical techniques to search through the many potential solutions. The second paper in this group is by Marian Leimbach and colleagues, who look at uncertainty and advance a methodology to address the problems arising. They use a concept called tolerable windows, a climate-specific variant of safe minimum standards. The paper 'solves' the required inversion of a nonlinear model by means of the dual of a standard optimization. The study also highlights the high degree of uncertainty surrounding climate change and a large majority of environmental problems.

The last two papers focus on techniques for solving integrated assessment and/or economic-ecological models.¹ The first, by Anantha Kumar Duraiappah, focuses on solving nonlinear economic-ecological models using the GAMS package. The paper begins by highlighting the critical factors a modeler should address or bear in mind when formulating economic-ecological optimizing models. The second part of the paper provides a systematic approach to solving the models in GAMS. Duraiappah stresses that, although significant advances have been made in non-linear optimization algorithms, finding feasible and optimal solutions with these algorithms is still an art. The second paper, the last in this issue, is by David Kelly and Charles Kolstad, who address some of the more difficult which can arise in integrated assessment models – infinite horizon and stochasticity. They develop an algorithm using a feed-forward neural network as a flexible functional form and, together with dynamic programming techniques, solve this class of complex models. Although the algorithm in its present form is computationally intensive and is hampered by the curse of dimensionality, it nevertheless sets the pace for future research in solving this important and politically relevant class of models.

We hope that this special issue highlights some of the advantages and strengths in using computational techniques when addressing issues relating to economics and the environment. The broad range of topics covered by the five papers was intentional: we wanted to demonstrate how a variety of computational techniques could be used to address a range of issues in much deeper detail than analytical tools would have permitted.

We would like to thank the authors for their patience with us as well as with the demanding requirements of the reviewers. We should like to thank the editor of *Computational Economics*, Hans Amman, for providing support for this endeavor.

Note

¹ The term integrated assessment and economic-ecological models are very frequently used interchangeably. We shall assume in this paper that they are similar.

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April 2001*